REMARKS

The above amendments to the above-captioned application along with the following remarks are being submitted as a full and complete response to the Official Action dated October 21, 2003.

Claims 1-20 are under consideration in this application. Claims 1 and 12 are being amended, as set forth above, in order to more particularly define and distinctly claim applicants' invention. Applicants hereby submit that no new matter is being introduced into the application through the submission of this response.

In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

Prior Art Rejections

Claims 1-3, 11, 13, 14 and 16-20 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Pat. No. 6,297,122 to Eguchi et al. (hereinafter "Eguchi"), claims 4-10, 12 and 15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Eguchi in further view of U.S. Pat. App. Pub. No. 2001/0006838 to Won (hereinafter "Won") and U.S. Pat. No. 6,617,248 to Yang (hereinafter "Yang"). These rejections have been carefully considered, but are most respectfully traversed.

The fabricating method of a semiconductor integrated circuit of the invention, as now recited in claim 1, comprises forming a ruthenium electrode of a capacitor with high-k material on a semiconductor substrate by a chemical vapor deposition method in a sub-atmospheric pressure using an organoruthenium compound as a precursor, which includes: a first step of providing the semiconductor substrate in a deposition chamber, increasing a temperature of the semiconductor substrate in the chamber up to a desired temperature; a second step of separately supplying the precursor and an oxidation gas into the deposition chamber to form a ruthenium film with a desired thickness on the heated semiconductor substrate, said oxidation gas being separately supplied to said deposition chamber by a supplying system different from a precursor supplying system; and a third step of stopping the supply of the precursor and said oxidation gas

and decreasing the temperature of the semiconductor substrate (page 18, lines 23-24). As such, the supply of the oxidation gas is *separately controlled* from the supply of the precursor and **only during** the precursor-supplying step (Figs. 1-4) thereby (1) limiting the introduction of the oxidizing gas only in the period of introducing the material gas; (2) reacting the material gas under a low partial pressure of oxygen; and (3) controlling the oxidizing gas supply by supplying the oxidizing gas and the carrier gas separately (p. 19, lines 5-20; p. 7, lines 20-25; Fig. 7). Accordingly, "*the amount of oxygen contamination in the ruthenium film [becomes] less than the detection limit by a TDS measurement* (page 31, lines 1-3)."

The invention, as now recited in claim 12, is directed to a fabricating method of a semiconductor integrated circuit comprising: forming a capacitor bottom electrode made of a ruthenium metal film Ru on a semiconductor substrate by a chemical vapor deposition method in a sub-atmospheric pressure using an organoruthenium compound as a precursor (e.g. $Ru(C_5H_4C_2H_5)_2$) and oxygen; and immediately thereafter performing annealing at not less than a formation temperature of the bottom electrode made of said ruthenium metal film in a reducing atmosphere containing hydrogen thereby removing oxygen introduced into a surface of said ruthenium metal film when said ruthenium metal film is formed therefrom (page 31, last paragraph) and inhibiting deformation of crystal grains of the bottom electrode made of said ruthenium metal film in the annealing step during or after forming a high-k capacitor insulator ("*The ruthenium film formed with the foregoing annealing method is not deformed and is stable against the subsequent high-k dielectric film formation and annealing for crystallization.*" Page 30 line 24 to page 31, line 1). According, the invention eliminates oxygen included in the ruthenium film by heat treatment in reducing atmosphere, therefore eliminates the prior art problem of including slight amounts of oxygen in a ruthenium film which affect a barrier metal film by oxidizing the barrier metal film formed between a plug and ruthenium electrode in a heat treatment (p. 4, line 8 to p. 5, line 3) thus increase the resistance of the barrier metal.

Applicants respectfully contend that neither Eguchi nor Yang, or their combination as relied upon by the Examiner, teaches or suggests the features of (a) "**simultaneously but separately supplying** the precursor and an oxidation gas into the deposition chamber to form a ruthenium film with a desired thickness on the heated semiconductor substrate, then simultaneously stopping the supply of the precursor and the oxidation gas when cooling the semiconductor substrate (claim 1)" thereby reacting the material gas under a low partial pressure of oxygen; or (b) performing annealing at not less than a formation temperature of the bottom

electrode made of said ruthenium metal film in a reducing atmosphere containing hydrogen thereby removing oxygen introduced into a surface of said ruthenium metal film when said ruthenium metal film is formed therefrom and inhibiting deformation of crystal grains of the bottom electrode made of said ruthenium metal film Ru in the annealing step during or after forming a high-k capacitor insulator (claim 12).

Regarding claim 1, Eguchi was the primary reference relied upon by the Examiner. Eguchi opens the valve 226 to start supplying the O_2 gas (col. 5, lines 62-63), and **continues** supplying the oxidizing gas **even after** the cooling period when **the supply of the precursor is stopped** (*"during this cooling period, the O_2 gas is kept supplied"* (col. 6 line 5), rather than simultaneously stopping the supply of the precursor and the supply of the oxidizing gas during the cooling period as the present invention. Like the prior art described on page 8, lines 2-4 of the specification, Eguchi's ruthenium surface is oxidized because the oxidizing gas is continuously supplied to the ruthenium surface after the material gas supply is stopped.

Even more, Applicants contend that one skilled in the art would not be motivated to look into the teachings in Eguchi in the manner suggested by the Examiner due to their conflicting principles of production. Specifically, Eguchi purposefully produces a metal **oxide** ($SrRuO_3$; col. 5, lines 5-6) electrode, i.e., **promoting** the O contents therein, while the invention deliberately provides a metal (Ru) electrode and **reduces** the possibility for O elements oxidized onto the surface of the metal (Ru) electrode. It is well established that a rejection based on cited references having contradictory principles or principles that teach away from the invention is improper. Yang shares the same deficiency by internationally forming a RuO_2 film (rather than a Ru film). Won fails to compensates for the deficiencies.

Regarding claim 12, Won was relied upon by the Examiner to teach "a material gas of ruthenium CVD formation", and Yang was relied upon by the Examiner to teach "annealing at not less than a formation temperature of the bottom electrode made of said ruthenium metal film in a reducing atmosphere containing hydrogen." Yang internationally forms **a RuO_2 film**, then uses a hydrogen-rich gas and heat treatment to react O element from the whole RuO_2 film (col. 2, line 60 to col. 3, line 58). This approach conflicts with the invention's approach of forming **a Ru film** and then removing oxygen introduced into said ruthenium metal film when said ruthenium metal film is formed using oxygen oxidized on a surface of said ruthenium metal film therefrom by heat treatment. As to Eguchi, it does not even mention turning a $SrRuO_3$ metal oxide film into a Ru metal film. Won fails to compensate for these deficiencies.

Applicants contend that neither cited prior art reference, nor their combination teaches or suggests each and every feature of the present invention as disclosed in independent claims 1 and 12. As such, the present invention as now claimed is distinguishable and thereby allowable over the rejections raised in the Office Action. The withdrawal of the outstanding prior art rejections is in order, and is respectfully solicited.

In view of all the above, clear and distinct differences as discussed exist between the present invention as now claimed and the prior art reference upon which the rejections in the Office Action rely, Applicants respectfully contend that the prior art references cannot anticipate the present invention or render the present invention obvious. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable reconsideration of this application is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and phone number indicated below.

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